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FEBRUARY 1918

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Official Organ of the

American Phytopathological Society

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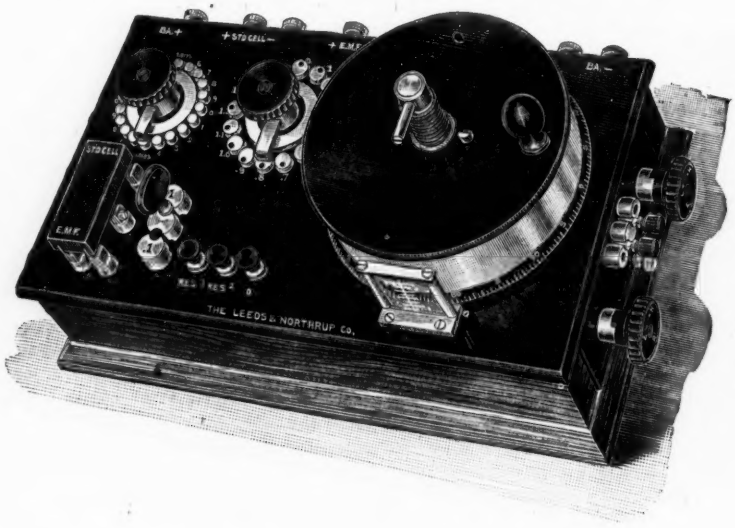

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PHYTOPATHOLOGY

VOLUME VIII NUMBER 2

FEBRUARY 1918

NOTES UPON A MARKET DISEASE OF LIMES

O. T. Wilson

With Five Figures in the Text

During the winter of 1916–1917 the writer made some observations upon a disease of limes which is very common on the fruit in the Cincinnati, Ohio, markets. The disease was at first thought to be the same as the brown rot of lemons described by R. E. Smith[1] as occurring on citrus fruits in California, but cultural experiments have failed to prove the presence of a fungus that could be definitely classified. Smith found the causal organism of brown rot to be *Pythiacystis citrophthora* R. E. Smith. In a communication from Washington, Dr. H. R. Fulton states that, although he has made numerous tests from diseased limes, he has not found the above organism. He states that he has frequently found *Diplodia natalensis* Ev. on diseased fruits but is not certain that it is a primary cause of the rot that accompanies its presence. As the investigations here recorded have not shown the presence of either of the above-mentioned fungi it seems probable that the disease here described is due to a fungus which has not been previously recorded as occurring on limes. A brief statement of the nature and results of the cultural experiments may therefore be of value.

The disease is of such common occurrence on the fruit in Cincinnati markets that there is no difficulty in securing ample material for investigation. Almost any lot of fruit will include some diseased specimens. These may be recognized by the presence of more or less discolored surface areas which are quite smooth in contrast with the surrounding rather papillose surface characteristic of the rind of citrus fruits. The discoloration is usually proportional to the size of the areas showing the infection. The color varies from a deepened yellow to orange or copper color, the margin of the spot being distinctly brownish in the most typical specimens.

[1] Smith, R. E. The brown rot of the lemon. California Agr. Exp. Sta. Bul. 190: 1–70. 1907.

Color characteristics are variable, however, and cannot be relied upon for conclusive identification of the disease. The discoloration is usually heightened as the fruit dries. The distinctly smooth spot with sharply elevated margin is the best macroscopic indicator of the trouble. Such spots are characteristically shown in figure 1.

Upon opening a diseased fruit an abnormal odor may be detected. As limes are normally very sour the slightly altered taste of a diseased fruit would hardly be a subject of comment to the consumer unless the disease were far advanced. It is frequently the case that a fruit shows almost no external evidence of the disease and yet its internal tissues are badly infected. This indicates that the causal organism is well adapted to sustain itself in the acid juices of the fruit. Microscopic examination of the interior tissues of a diseased fruit shows that it is occupied by a filamentous fungus. As the acid juice of the lime is unfavorable to the growth of bacteria the isolation of the fungus is a simple matter.

After the surface of a diseased fruit is disinfected with a weak formaldehyde solution the interior is practically a pure culture of the invading organism. Such cultures may be kept for weeks without any surface progress of the disease. To obtain plate cultures the rind is punctured with a sterile needle and a drop of the juice squeezed into a plate containing the melted culture medium preferably a nutrient agar. One per cent standard peptone beef extract agar is satisfactory. The bits of fungus are distributed by rolling and in twenty-four hours the colonies usually appear. The writer has used this method again and again without bacterial contamination of the plates.

Cultures were continued on agar plates and in agar tubes for several weeks in an effort to find the fungus sporulating, so that it might be identified, but without success. The growth was white and cottony, not very rapid, and in the tubes did not keep pace with the drying of the agar, eventually becoming separated from it. Uninfected limes were readily inoculated from the agar cultures, showed the characteristic progress of the disease, and the fungus was reisolated from them by the method described above. Inoculation was successful either by surface contact or by needle puncture.

The fungus was next grown in prune juice with the idea that a more liquid medium might encourage sporulation. The fungus grew rapidly in the tubes; the growth was white at first but soon began to show black radiating knots of mycelium in the upper layers. These enlarged until the entire growth was coal-black in color. As the medium became exhausted and the culture dried out, a black mass of mycelium was left in the test-tube, which when removed was as hard as a piece of coal and when rubbed between the fingers was reduced to dry powder, leaving

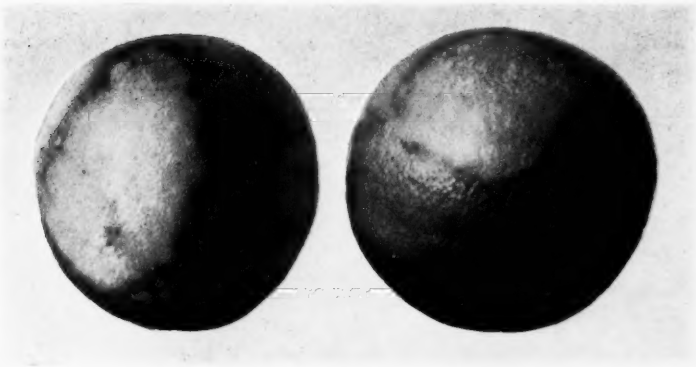

FIG. 1. INFECTED LIMES AS FOUND IN THE CINCINNATI MARKETS

FIG. 2. PORTION OF CORNMEAL PLATE SHOWING THE STROMA-LIKE ELEVATIONS OF THE SURFACE GROWTH, IN MANY CASES WITH CENTERS SUGGESTING OSTIOLES

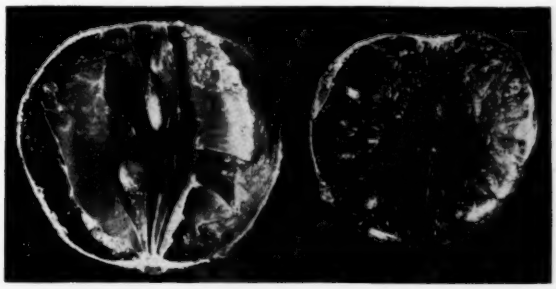

FIG. 3. MUMMIFIED FRUITS AFTER CUTTING

Note that the carbonaceous contents of the infected fruit at the right readily separate and fall out. The tissues of the uninfected fruit have merely dried.

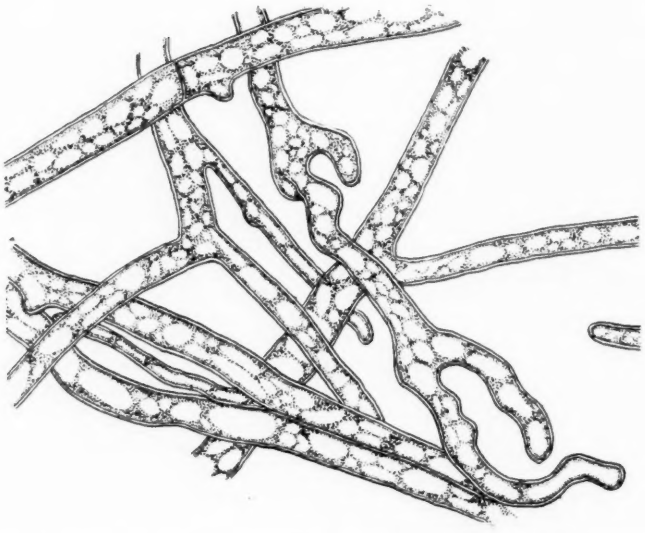

FIG. 4. VARIOUS MORPHOLOGICAL FEATURES OF THE LIME FUNGUS

From growth on agar. Camera lucida drawing with 1/6 objective and no. 18 compensating ocular.

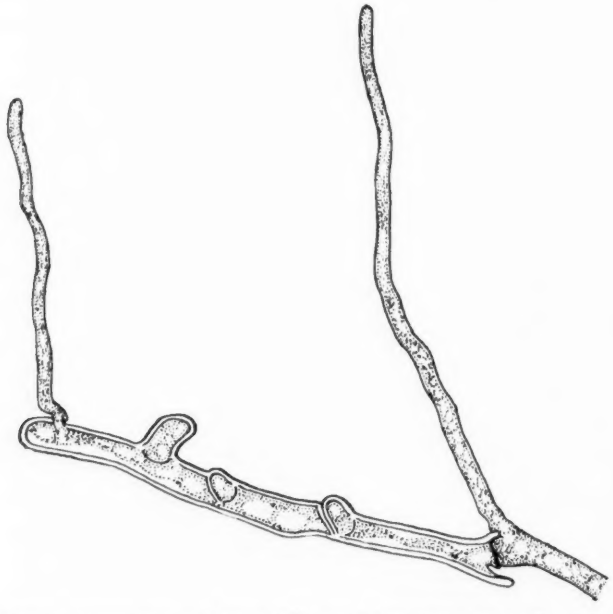

FIG. 5. GERMINATION OF A DRIED BIT OF MYCELIUM IN A CULTURE SLIDE

Such bits of mycelium apparently serve the same purpose as resistant spores. Camera lucida drawing, combination as for figure 4.

those members blackened as if by soot. The culture had been so different from the agar culture that contamination was suspected. Transfers of portions of the black growth were made to agar plates and tubes and the white growth previously noted on the agar was again obtained. The cultures in prune juice were carefully examined at all stages for spores but with negative results. The dry, blackened masses were found to consist of dense brown mycelium which readily broke into minute segments. Inoculations from prune juice cultures in all stages were successful. A very efficient method was to spray the uninfected fruits with a suspension of the dry bits of mycelium in sterilized water. A hand atomizer was used for this purpose.

The next medium employed was sterilized soil in plates. The fungus made a fair growth, spreading over the surface as a loose web of white hyphae. The growth was carefully watched but no signs of spores appeared. Fresh limes were infected from the soil plates by placing the fruits in direct contact with the fungus growth and leaving in a sterilized moist chamber. Control limes were not infected.

Distilled water was next used as a medium in the hope that attenuation of the culture might result in sporulation. The results were negative.

The last medium employed was cornmeal mush which forms a gelatinous layer when poured thin in plates. This was the most favorable of the media employed, as to the rapidity and extent of the growth. The entire plate was usually covered with dense mycelium within three days of the transfer from another medium. As was true in the prune juice medium, the growth soon became black and carbonaceous in appearance and texture. Although allowed to dry out completely there was no sporulation; however, stroma-like surface growths were developed. Upon examination of the surface growth of some old prune juice cultures, similar elevations of the growth were noted. In many cases ostiole-like centers were present on the elevations. Microscopic examination of such growths, however, revealed no spores. The elevations are shown in figure 2.

The writer has not found spores in the tissues of the infected fruits although many specimens have been examined. Such fruits were allowed to mummify side by side with uninfected fruits, after sterilizing the surfaces to prevent Penicillium rot. After two months the external appearance of the limes had not markedly changed. Upon cutting the fruits, however, it was found that the diseased specimens were filled with black hard masses of mycelium corresponding to those in old cultures upon cornmeal and in prune juice. The uninfected fruits had dried normally. The contrast is shown in figure 3. The dried masses of mycelium from the infected mummy were readily reduced to powder and fresh fruits infected from the powder by spraying as described in a previous paragraph.

Microscopic examination of the powder failed to show the presence of any spores. When infected fruits were kept in a moist chamber (sterilized) they became covered with a dense black mycelium but no spores were formed.

On account of the absence of spores or other reproductive bodies than bits of the vegetative mycelium, it has been impossible to identify this fungus. It must be provisionally considered as one of the unsatisfactory and highly artificial group classified as Sterile Mycelia. The growth was white and cottony on some media while it was black and carbonaceous on others as noted above. The mycelium was branched in various ways. It was non-septate in some cases and with numerous cross walls in others. The filaments were separate or in fascicles (fig. 4). These varying morphological features of the same organism emphasize the futility of any classification based only on such characters.

The only method of reproduction revealed by the investigations was negative. It seems unquestionable that the mycelium in the mature dried condition of figures 2 and 3 is highly resistant, and viable even when hard and apparently lifeless. It readily gives rise to new infection when powdered and sprayed over uninfected fresh fruits. When such powdered mycelium is placed in water in culture slides, the tiny bits of mycelium soon put out actively growing hyphae as shown in figure 5.

SUMMARY

A common disease of limes from Florida bought in the Cincinnati markets was found to be due to the presence in the fruit of a fungus which grows readily on a variety of media. The cultural characteristics vary with the medium employed and the morphological features are also inconstant. Spores have not been found to be produced on the media used. The breaking up of the dried mycelium is the only method of dissemination apparent from the investigations. The classification of the causal organism is in doubt until sporulation can be induced.

UNIVERSITY OF CINCINNATI
CINCINNATI, OHIO

THE MOSAIC DISEASE OF PHYTOLACCA DECANDRA

H. A. Allard

With Two Figures in the Text

During the progress of investigations of the mosaic disease of tobacco, some attention was given to a similar mosaic disease[1] which frequently affects the perennial pokeweed, *Phytolacca decandra* L., growing in its wild state. Owing to the fact that the two diseases resemble each other in many respects, it was deemed well to determine what relationship, if any, exists between them. It was also thought that a better knowledge of the mosaic disease of pokeweed would perhaps throw additional light on the nature and distribution of the mosaic disease of tobacco.

In all phases of its expression the mosaic disease of pokeweed bears a very close resemblance to the mosaic disease which affects the tobacco plant. Although the sap of mosaic-diseased pokeweed plants will produce the disease in healthy pokeweed plants, the writer's experiments have thus far shown that it will not produce the mosaic disease in tobacco or other solanaceous plants, such as tomato, petunia, physalis, datura and solanum.

The non-susceptibility of healthy tobacco plants to the virus of mosaic-diseased pokeweed plants and the subsequent susceptibility of these same plants to the virus of the mosaic disease of tobacco was shown as follows: a series of tobacco plants was inoculated in various leaves with the virus of mosaic-diseased pokeweed plants, without producing any evidence of disease. Half of these plants were then inoculated with the virus of the mosaic disease of tobacco. The series inoculated with the virus of the mosaic disease of pokeweed alone remained healthy, while the second series soon became affected with the mosaic disease transferred from tobacco plants. These experiments have been repeated several times with the same results.

The sap of mosaic-diseased tobacco plants even when frequently inoculated into the plants for long periods has never produced the mosaic disease in healthy pokeweed plants.

The incubation period of the mosaic disease in pokeweed plants, as in

[1] Mentioned and illustrated with one colored plate by A. F. Woods, in Bulletin 18, Bureau of Plant Industry, United States Department of Agriculture, "Observations on the Mosaic Disease of Tobacco."

the mosaic disease of tobacco, depends upon conditions which affect the rate of growth and vigor of the plants. The disease frequently develops in twelve to fifteen days following inoculation.

In pokeweed plants as in tobacco plants the initial symptoms of the disease first appear in the immature, growing leaves, and the progression of the disease is then more or less coincident with the growth of new leaves and branches. The leaves frequently become beautifully mottled, and sometimes distorted in quite the same manner that the leaves of tobacco plants manifest the mosaic disease (figs. 1 and 2).

The disease may be communicated to plants when they are very young, or when the plants are well advanced toward maturity. If very young plants affected with the disease are growing under conditions favoring the development of very large, vigorous plants, the course of the disease is marked by a continuous development of beautifully mottled leaves. If the disease appears in nearly mature plants, the symptoms will be less evident, since they are confined to the recent shoots and leaves. This phase of the mosaic disease appearing in nearly mature plants corresponds to the "mottled top" or "gray top" phase of the mosaic disease of tobacco seen in nearly mature tobacco plants. Such plants blossom and produce berries quite as abundantly as healthy plants.

The writer has grown hundreds of plants from seed produced by mosaic-diseased pokeweed plants, but there has been no evidence to indicate that embryonic infection takes place from mosaic-diseased mother plants during the development of the seed. Observations of plants growing wild also furnish indirect evidence in confirmation of these results. The writer has found old isolated mother plants affected with the disease which were surrounded with a numerous progeny of young plants quite free from the disease.

The occurrence of the mosaic disease in pokeweed plants cannot readily be attributed to the direct influence of unfavorable soil conditions. In any locality healthy and mosaic plants frequently grow in close proximity. In several instances the writer has found diseased and healthy plants with their stems in contact, and their root systems completely interlacing in the same soil area.

Although Woods was led to believe that the mosaic disease could be produced in healthy pokeweed plants by simply cutting them back, the writer's experiments indicate that the most persistent and vigorous cutting back will not produce a true infectious mosaic disease in healthy pokeweed plants. The sap of diseased plants, however, does initiate the disease when inoculated into the tissues of healthy plants.

In its wild state, the perennial habit of the plant makes it possible for the disease to persist from season to season in the underground portions

FIG. 1. LEAVES OF HEALTHY AND MOSAIC-DISEASED POKEWEED PLANTS
Healthy leaf at left; mottled leaf from mosaic-diseased plant at right. T. I. 1476.

FIG. 2. LEAVES FROM MOSAIC-DISEASED POKEWEED PLANTS
The leaves show various degrees of mottling. T. I. 1472.

which survive the winter. In such plants the expression of the disease each season is coincident with the growth of new shoots.

Since the mosaic disease may occur with greater frequency in some localities than in others, it appears that the natural spread of the disease is in some way dependent upon local influence.[2] The spread of the disease, however, is not in any sense dependent upon an air-borne contagion. From the fact that the sap of mosaic-diseased pokeweed plants possesses specific infective properties when introduced into the tissues of healthy plants and it is known that a natural dissemination of the infective principle takes place, there is every reason to suspect that carriers of infection at times become active. It is very probable that certain insects may act as carriers of infection as in the case of the mosaic disease of tobacco.

In early spring and summer the writer has on several occasions observed great numbers of very large aphides (*Macrosiphum* sp.) upon mosaic-diseased pokeweed plants. It was noted that these insects usually disappeared very suddenly and mysteriously somewhat later in the season, a not uncommon habit with aphides during certain migratory movements. It is possible that these or other insects may become important disseminating agencies for this disease.

During a study of this disease and the mosaic disease of tobacco in the greenhouse at Arlington, Virginia, some interesting observations were noted concerning the spread of the two diseases under these conditions. Healthy and mosaic-diseased pokeweed and tobacco plants were growing side by side at all times. Although aphides were active in the spread of the mosaic disease of tobacco to susceptible solanaceous plants throughout the greenhouse, in no instance did the mosaic disease of pokeweed make its appearance in healthy plants until experimental inoculations were made with a needle. This would seem to indicate that insects capable of acting as carriers of the infective principle were not present in the greenhouse during this period.

Although the mosaic disease of pokeweed is of no particular economic significance at present, yet it is always possible that a better understanding of the nature, origin, and spread of one disease may serve to throw considerable light on other similar diseases of this class.

OFFICE OF TOBACCO AND PLANT NUTRITION INVESTIGATIONS
UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

[2] The common practice of cutting the young, tender sprouts of pokeweed in springtime for greens probably aids very materially in spreading the disease from mosaic-diseased to healthy plants in many localities.

NOTES ON THE OVERWINTERING OF FOREST TREE RUSTS

JAMES R. WEIR AND ERNEST E. HUBERT

The habit of wintering over in the alternate stage of rusts which attack forest trees[1, 2, 3, 4] is proving to be of more than ordinary interest. It is especially interesting to note the collection of the uredinial stage of *Melampsora bigelowii* Thüm. on stems (N. A. U. 1617) and catkins of species of Salix in connection with the habit of overwintering on this host. The first collection by this Laboratory was made at East Tawas, Michigan, on May 17, 1916, and later at Haugan, Montana, on June 18, 1917. The younger portions of the stems of one large clump of willows at Haugan were found heavily infected with the rust which appeared to have been mature for some time. Very few leaves were found infected on this clump and the majority of these infections were not fully mature. Another smaller clump was found having the stems heavily infected and without a single infection on the leaves. The infected stems bore indications of the past season's uredinial eruptions, the discolored and partly dead areas resembling cankers but with the epidermis broken open in many places. These observations seem to indicate that the rust wintered over in the willow stems in the form of mycelium and broke out in pustules at an early date. The urediniospores thus produced infected the young leaves of the willow followed by characteristic uredinial pustules. This conclusion is borne out by observations made by Bethel covering a period of thirteen years and corroborated by his collections of the fungus on willow stems (Barth. N. A. U. 1617). The Sydows[5] state that besides appearing on leaves of Salix, *Melampsora salicis-albæ* Kleb. ruptures from the bark of young twigs in early spring. The continuation of the rust from year to year on willows in a region far removed from its alternate host, *Larix* sp. (N. A. U. 1617, attached note), is apparently due to this habit of overwintering. Bethel in a letter of April 19, 1917, states that "two other

[1] Clinton, G. P. Heteroecious rusts of Connecticut having a Peridermium for their aecial stage. Rpt. of the Station Botanist. Conn. Ag. Exp. Sta. **1907**: 369. 1907.

[2] Ludwig, C. A. Continuous rust propagation without sexual reproduction. Proc. Indiana Acad. Sci. **1914**: 219. 1914.

[3] Mains, E. B. The wintering of Coleosporium solidaginis. Phytopath. **6**: 371–372. 1916.

[4] Weir, J. R., and Hubert, E. E. Observations on forest tree rusts. Amer. Jour. Bot. **4**: 327–335. Je. 1917.

[5] Sydow, P. and H. Monographia Uredinearum. **3**: 335. Fasc. II. 1914.

methods of wintering over are common on the willows, namely, in the terminal buds of *Salix geyeriana* and in catkins ~~and~~ buds of certain other species. The former produces the most beautiful rosettes with leaves much aborted and the other develops the Melampsora directly in the catkins." Collections of the rust on the catkins of *Salix* sp. have been made by members of this office. The first collection recorded is from Philipsburg, Montana, made on June 30, 1917, and shows the pistillate catkins very heavily infected with the uredinial stage. In another collection made at Mackay, Idaho, on July 9, 1917, the stem, the leaf petiole, and the base of each leaf were found heavily infected. The leaves and petioles bore the majority of the infection. This indicates a progression of the rust from the stem into the more tender petiole and leaf.

Another interesting case of overwintering is found in *Melampsoropsis pyrolæ* (DC.) Arth. infecting species of Pyrolaceæ. The uredinial stage of the rust appears upon the leaves of *Pyrola* spp. very early in the spring almost as soon as the snow has left the ground. The earliest collection made this season was at Priest River, Idaho, on May 11, 1917, and at Evaro, Montana, May 28, 1917. At the time of collecting there was no possibility of aecial infection from pistillate cones of Picea since these were not even formed. The pycnial and aecial stages on young cones of *Picea engelmanni* were found on July 12, 1917, at Evaro, Montana, and at that time all vestage of the uredinial stage on Pyrola had disappeared leaving nothing but the browned and dried leaves bearing possibly the telial stage. The new green leaves were almost invariably without visible infection.

These observations lead to the conclusion that the leaves of the Pyrolaceæ become infected late in the season by the aeciospores developed on the spruce cones; that the infection winters over in the evergreen leaves and develops uredinia very early in the following season. This conclusion develops a life history for the rust which fits in with the time of appearance of the young cones which develop about the middle of the summer. The early development of uredinia cause a production of telia at about the time the young cones are susceptible to infection. A few collections of the uredinial stage on Pyrolaceæ made in October, 1916, indicate a divergence from the above conclusion but there is no reason why this stage should not occasionally develop in the latter part of the same season if the aecial stage on the spruce cones are developed early enough and sufficient time elapses before cold weather to produce the uredinial stage of the Pyrolaceæ. The majority of uredinial infections have been found in the early part of the season. Clinton[6] states that "Apparently the

[6] Clinton, G. P. Rpt. of the Station Botanist. Conn. Ag. Exp. Sta. **1907**: 388. 1907.

* corrected, p. 551

aecial stage is not necessary for the appearance of the rust, as the leaves of the Pyrolæ frequently live over the winter and could easily carry over the uredinial stage."

Fraser[7] in 1912 records successful cultures of this rust on young cones of *Picea mariana*, and previous to this he records[8] the close association of the rust on Pyrolaceæ with the rust found on the cones of spruce in the region of Pictou, Nova Scotia.

The cultural data and the observations of Fraser bear out the field observations made at Evaro, Montana, regarding the close proximity of the infected cones of spruce to the patch of heavily infected Pyrolas and also check Fraser's results and observations.

The uredinial stage of *Pucciniastrum pustulatum* (Pers.) Dietel on *Epilobium adenocaulon* kept in the greenhouse since October 18, 1916, has continued to produce uredinia at regular intervals up to August 20, 1917. *Coleosporium solidaginis* (Schw.) Thüm. in the uredinial stage was collected early in the season, April 29, 1917, at Darby, Montana, on *Aster* spp. before any evidence of the aecial stage on the needles of *Pinus contorta* could be detected. These observations are a continuation of the experiments reported in an earlier paper.[4]

In Europe *P. epilobii* Otth.[9] on *Epilobium adenocaulon* and several other species winter over in the evergreen portions of the plants in the uredinial stage. The telial stage is very rare and inconspicuous. This fungus approaches more nearly the Pucciniastrum found in this country on *Epilobium adenocaulon*. So far no telial stage has been found for the latter fungus and in this respect differs from *P. epilobii*. Also the method of wintering over is, so far as observed, restricted to the overwintered rosettes.

Repeated attempts to secure infections on *Epilobium angustifolium* with urediniospores developed on *Epilobium adenocaulon* have resulted negatively. A healthy plant of *E. angustifolium* was bent over until the tender leaves of the tip were in contact with the uredinial pustules on *E. adenocaulon*. The plants were kept moist and after 28 days no infection developed on *E. angustifolium*. This seems to indicate a species of Pucciniastrum on *E. adenocaulon* distinct from that developing on *E. angustifolium*.

Owing to the fact that the uredinial stage of *Pucciniastrum pyrolæ* (Pers.) Dietel found on Pyrolaceæ has been collected in almost every month of the year, it is apparent that the rust overwinters on this evergreen host and propagates by means of urediniospores. So far no alter-

[7] Fraser, W. P. Cultures of heteroecious rusts. Mycologia **4**: 183. 1912.
[8] Fraser, W. P. Cultures of some heteroecious rusts. Mycologia **3**: 70. 1911.
[9] Sydow, P. and H. Monographia Uredinearum. **3**: Fasc. III. p. 444. 1915.

nate host has been found carrying the pycnial and aecial stages of the rust although the presence of the telial stage would indicate an alternate stage on some coniferous host. Of this fungus Clinton[10] says, "the only specimens collected in this state [Connecticut] were of the II stage" and "Apparently the fungus carries over the winter through the uredinia on infected leaves."

Another very interesting case of overwintering known to European writers and not previously reported for this country is that of *Melampsoridium betulinum* (Tul.) Kleb. (*M. betulæ* (Schum.) Arth.) occurring on species of Betula. Sydow[11] states that Liro in Finland found a different life history of the fungus from that in middle Europe and in England. Liro found that the urediniospores, either in dry or moist stage or the mycelium, were capable of wintering over in the tissues of the leaves and buds of seedlings but not in those of older trees. From these infections on the seedlings the rust spreads to the leaves higher up on the larger trees finally infecting the entire tree. The fungus was found on birch in parts of Scandinavia and Russia where Larix was unknown.

Since 1912 collections of the uredinial stage of *M. betulæ* on *Betula occidentalis* and *Betula glandulosa* have been made annually at Priest River, Idaho. Repeated attempts have been made to find the telial stage and to culture this stage on species of Larix but without success. The aecial stage on *Larix* spp. has not been collected in the northwestern region up to the present time. Overwintered leaves bearing traces of the past season's uredinial eruptions were repeatedly sown on *Larix* spp. with negative results. Near Priest River where many collections have been made the rust appears annually upon the same clumps of birch and always develops first on the lowermost leaves. The infection is especially heavy on the smaller plants of *B. glandulosa* growing in sphagnum bogs. The fact that no collections of the aecial stage on Larix have been made in this region, as well as in other regions in North America, indicates an autoecious form of the rust.

Clinton[12] in 1907 suspected the fungus of overwintering and states that the uredinia may possibly occur on the young twigs and by this means carry the fungus over the cold months. Some such method may be found and would be a parallel case to the overwintering of *Melampsora bigelowii* in stems and buds of Salix.

The only example of overwintering of a species of Cronartium is that

[10] Clinton, G. P. Rpt. of the Station Botanist. Conn. Ag. Exp. Sta. **1907**: 393. 1907.

[11] Sydow, P. and H. Monographia Uredinearum. **3**: Fasc. III. p. 425. 1915.

[12] Clinton, G. P. Rpt. of the Station Botanist. Conn. Ag. Exp. Sta. **1907**: 386. 1907.

of *C. cerebrum* (Pk.) H. & L. According to Meinecke[13] this rust overwinters on the evergreen leaves of *Quercus agrifolia* and *Q. durata* producing urediniospores in the spring from the old telial spots of the previous year. The urediniospores are then capable of infecting the young leaves of the season.

SUMMARY

Additional evidence is presented of the wintering over habit of certain forest tree rusts.

The data presented indicate that *Melampsora bigelowii* on willows, *Melampsoropsis pyrolæ* on Pyrolas, *Pucciniastrum* spp. on *Epilobium adenocaulon*, *Melampsoridium betulæ* on birch, and *Pucciniastrum pyrolæ* on Pyrolas winter over by means of the uredinial stage. The *Pucciniastrum* sp. on *Epilobium adenocaulon* is found to resemble very closely *P. epilobii* of Europe in its habit of wintering over.

These overwintering studies are important from the viewpoint of explaining the repeated occurrence of normally heteroecious rusts in regions far removed from their alternate hosts.

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BUREAU OF PLANT INDUSTRY
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[13] Meinecke, E. P. Peridermium harknessii and Cronartium quercuum. Phytopath. **6**: 239. 1916.

REVIEWS

Laboratory Outlines in Plant Pathology. By H. H. Whetzel, Lex R. Hesler, Chas. T. Gregory, and W. Howard Rankin. New York State College of Agriculture, Cornell University. Pp. 1–207. Ithaca, N. Y., 1916.

It is a pleasure again to note the advent of a distinctly American text book of Phytopathology. The senior author is the pioneer of America —perhaps we should say of the world—in the practise of intensive teaching methods in that field. It is fitting, therefore, that, with the cooperation of his associates on the Cornell faculty, he should give us the first intensive laboratory manual. Every chapter of the book bears witness to practical class room experience and shows the aim to meet squarely the teacher's problems. This requires that it have strongly the individualistic stamp which is at once the strength and weakness of the book. It is avowedly a Cornell book with no attempt at compromise. This is most strikingly shown in its basis of classification, presenting first a series of necrotic diseases, then hypoplastic, and closing with metaplastic In this connection one is led to inquire whether hyperplastic would not be preferable to metaplastic as here used. This would seem in better accord with European usage as expressed by Küster and with accepted medical usage.

The conventional method in courses in plant pathology has been to base the classification either on causal agents, as is done in practically all European manuals and in the American texts by each Duggar and Stevens, or to classify by hosts, as in some of the more popular European works and in Stevens and Hall. Every pathologist will sympathize with the desire to emphasize the distinctly pathological viewpoint as contrasted with the mycological, on the one hand, and the host or cultural on the other. After examining the results, however, one may be left in doubt as to whether the present classification really goes far enough in accomplishing this to justify the sacrifice of opportunity for comparative studies inherent in either of the other plans.

The authors have faced clearly the fact that the terminology of phytopathology is inexact and cramped, and they have made commendable efforts to define and expand it. Perhaps the results along these lines will constitute the most influential contribution of the book to general phytopathological science. These are brought together in a brief but

evidently very carefully wrought glossary, of which, as the authors state, the definitions do not always agree with either the dictionaries or previous phytopathological literature. Here are found not only clear and satisfactory definitions of certain terms, like *inoculation* and *infection*, which are often confused, but the introduction of some new or little used terms, like *inoculum*, for which we predict a hearty welcome by experimental pathologists. One can not feel so sure that it is justifiable to put a new or restricted meaning into a word already in established usage, e.g., *pathogenesis*, or to introduce the term *saprogenesis* as here defined, though all must agree that it would be convenient to have single contrasted names for the two life phases of such parasites as have a saprophytic stage.

The book contains many pertinent suggestions as to teaching methods, some of which are distinctly new, e.g., as to special questions and topics for report and literature reviews. The pedagogical usefulness of the book will, however, doubtless be improved in the second edition by such critical editing and proof reading as will eliminate certain typographical errors or inconsistencies. An example deserving especial consideration from the teacher's standpoint is the terminology of the rust spore forms where the usage in these outlines varies somewhat with different hosts. Another, though perhaps less important matter, relates to the capitalization of species names. These should, as guides to students, be capitalized with scrupulous consistency, following some accepted rule, or else all be decapitalized, as the reviewer believes more expedient.

Whatever may be one's judgment relative to such minor matters, there must be universal welcome and general endorsement of this work as a most important and valuable contribution to educational advancement in phytopathology. The outlines relating to fruit and garden crop diseases are especially rich in evidence of direct personal acquaintance with the topics, many indeed having been the subjects of intensive investigation by Cornell men. Every working pathologist, and investigator as well as teacher, will therefore wish them constantly within reach. The book constitutes another welcome piece of evidence of the prominent and permanent place plant pathology has come to occupy in American schools.

L. R. JONES

PHYTOPATHOLOGICAL NOTES

Rhizoctonia as a needle fungus. Clinton[1] has reported finding Rhizoctonia attacking needles and young stems of coniferous nursery stock. In this connection an observation of the writer's may be of interest. At a nursery at an elevation of 7300 feet, in the Wasatch Mountains of Utah, one-year old Douglas fir seedlings examined about ten days after the snow left the beds in the spring were found to have numerous needles with killed areas of a rather unusual type. The lesions were conspicuously reddish in color, and ordinarily did not involve the tips of the needles. Two of these lesions were planted in agar plates, and both readily yielded vigorous growth of Rhizoctonia. The strains thus obtained differed from strains of the Rhizoctonial stage of *Corticium vagum* var. *solani* only in forming rather small sclerotia, and developing in culture a redder mycelium than is usually found. A large number of cultures were made at the same time and in the same way from dead parts of other seedlings not showing the typical lesions described above, without in any case obtaining Rhizoctonia. The Rhizoctonia was, therefore, not a generally distributed saprophyte, and its prompt growth from the lesions described furnishes ground for believing that it caused them. The writer has not commonly observed this type of lesion elsewhere, and does not believe it to be of any great economic importance in the western nurseries.

CARL HARTLEY

New hosts for Razoumofskya laricis. In a small, narrow canyon near Victor, Montana, opening into the Bitter Root Valley, a condition exists which is unsurpassed for a study of the host relationship of the false mistletoes. The sides of the canyon are bounded by mountains showing a well-marked timber line. The slopes are bare and rocky with little or no timber. The canyon floor, however, is densely forested with a mixed stand of *Pseudotsuga taxifolia*, *Pinus ponderosa*, *P. contorta*, *P. albicaulis*, *Thuja plicata*, *Abies grandis*, *A. lasiocarpa*, *Larix occidentalis*, and various hardwoods common to the region. Three species of Razoumofskya are abundant, viz., *R. americana* (Nutt.) Kuntz., *R. douglasii* Engelm., and *R. laricis* Piper. No other mistletoes occur. This combination of

[1] Clinton, G. P. Rhizoctonia blight. Connecticut Agr. Expt. Sta. 39th Ann. Rpt. **1915**: 450. 1916.

species, together with the large number of forest trees, makes an admirable place for field observations on the host range of these mistletoes. *R. laricis* is particularly abundant on Larix and was also collected on *Pinus contorta*, *Picea engelmanni*, *Abies lasiocarpa*, and *Pinus albicaulis*. The last three are new hosts here reported for the first time. *R. douglasii* was common on *Pseudotsuga taxifolia* and was collected on *Picea engelmanni* and *Abies grandis*. This mistletoe has been reported on these hosts before but under varietal names. *R. americana*, the common mistletoe of *Pinus contorta*, was found on *Pinus ponderosa*.

JAMES R. WEIR

Cronartium coleosporioides on Pedicularis grœnlandica. A collection of *Pedicularis grœnlandica* (*Elephantella grœnlandica*) bearing the uredinial and telial stages of a Cronartium collected at Big Springs, Idaho, was received at this laboratory on September 5, 1917. The leaves of the host were heavily infected and bore large masses of the telial horns on the lower surfaces. A study of the uredinial and telial stages indicates the fungus to be *Cronartium coleosporioides* (D. & H.) Arthur. The aecial stage of this fungus (gall form) was collected in abundance on *Pinus contorta* in the same area.

Bethel, in a letter of October 18, 1917, states that he had collected *Cronartium coleosporioides* on *Orthocarpus luteus* in 1915, and later (1917) he and Hunt collected it in abundance on *Orthocarpus purpureo-albus*, both collections having been made in Colorado. Bethel has kindly given permission for this citation.

Three genera are now listed as hosts for the above-named rust, namely, Castilleja, Orthocarpus, and Pedicularis.

JAMES R. WEIR AND ERNEST E. HUBERT

Dusting experiments in 1917. In 1915 and 1916[1] satisfactory results were obtained for the control of various leaf diseases of nursery stock by dusting with a mixture of 90 parts finely ground sulfur and 10 parts powdered arsenate of lead. The arsenate of lead was added not only for its value as an insecticide against chewing insects but also to improve the flowing qualities of the mixture. Pure sulfur in a finely ground state has a tendency to pack and does not flow well from the dusting machine. Since the lead arsenate greatly increases the cost of the dust mixture used, experiments were performed in 1917 for the purpose of testing the effectiveness of mixtures which are less expensive. In one case the amount of arsenate of lead was reduced to 5 per cent and in another

[1] Stewart, V. B. Dusting and spraying nursery stock. Cornell Univ. Agr. Expt. Sta. Bul. 385: 337–361. 1917.

mixture 10 per cent hydrated lime was substituted for the lead arsenate.

In an experiment for the control of *Fabræa maculata* (Lév.) Atk. on quince, the plats were arranged so that a part of each of nine rows of trees was included in each plat. There were seven plats, each consisting of several hundred trees, treated as follows: Plat 1, sprayed with lime-sulfur solution 1 to 40; plat 3, dusted with sulfur 90 parts and 10 parts hydrated lime; plat 4, dusted with sulfur 95 parts and lead arsenate 5 parts; plat 6, dusted with sulfur 90 parts and lead arsenate 10 parts; plats 2, 5, and 7 were left untreated.

Six treatments were made during the summer and final data on the experiment recorded September 12. The middle row was selected and the number of infected leaves counted on ten trees in the central area of each plat. The percentage of diseased leaves for each plat was as follows: lime-sulfur solution, 5.49 ± 1.38; sulfur 90 parts and lime 10 parts, 13.30 ± 2.53; sulfur 95 parts and lead arsenate 5 parts, 6.13 ± 1.40; sulfur 90 parts and lead arsenate 10 parts, 5.11 ± 0.99; untreated, 92.22 ± 2.11.

A similar experiment was conducted for the control of leaf-blotch, caused by *Guignardia æsculi* (Peck) Stewart, on three rows of horse-chestnut trees. Since previous results indicate that spraying with lime-sulfur solution is not satisfactory for the control of the leaf-blotch, this solution was omitted. A comparison of the different plats was obtained by selecting the middle row and counting the number of diseased and healthy leaflets on five trees in each plat. The percentage of infected leaflets for each plat was as follows: sulfur 90 parts and hydrated lime 10 parts, 15.82 ± 1.44; sulfur 95 parts and lead arsenate 5 parts, 4.99 ± 1.19; untreated, 99.20 ± 0.40.

From the results obtained in these experiments the five per cent reduction in the amount of lead arsenate apparently did not decrease the effectiveness of the dust mixture. On the other hand the substitution of hydrated lime for the lead arsenate reduced considerably the fungicidal value of the mixture.

V. B. STEWART

Sclerotium rolfsii on wheat. In view of the rather extensive interest that is now being shown in *Sclerotium rolfsii* as a parasite on a wide range of hosts, it is thought well to mention its occurrence on wheat.

During the spring of 1915, the writer noted blighted heads of wheat scattered irregularly through fields in certain parts of the South. In May, specimens were sent in to the laboratory of Cereal Pathology at Washington, D. C., by Dr. F. A. Wolf. He stated that approximately 5 per cent of the wheat in certain fields of the Alabama Experiment

Station at Auburn were affected in this way. The heads were apparently normal in size and general appearance, but were entirely devoid of grain. The appearance of the heads was such as to indicate premature ripening. Otherwise the plants appeared to be normal in the above-ground portions. No indications of insect injury were to be found in any part of the plant.

Careful examination of typical diseased plants disclosed brown lesions on the crown and lower portions of the culms. These lesions were small in area, but in some cases penetrated entirely through the wall into the hollow central portion of the culm. Fungus mycelium was present within the lesions. Isolations were made by sterilizing the surface of such areas with mercuric chloride and with alcohol and transferring bits of tissue

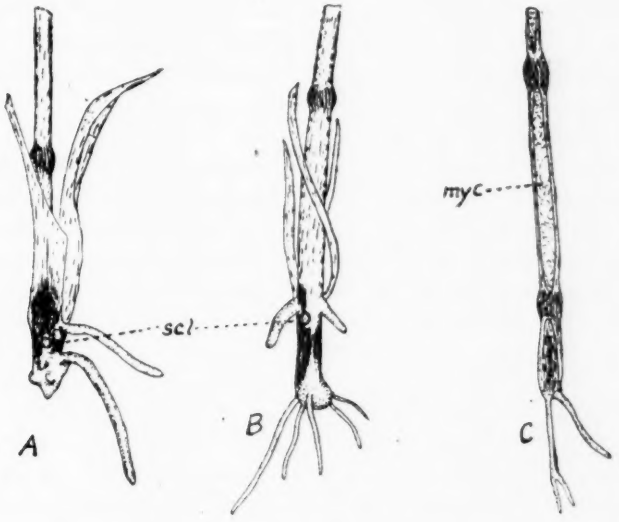

FIG. 1. SCLEROTIUM ROLFSII ON WHEAT

from freshly exposed areas to plates of nutrient agar. Pure cultures of *Sclerotium rolfsii* resulted in practically every attempt. The culture agreed in all characters with a stock culture of authentic *Sclerotium rolfsii*.

Inoculation experiments were conducted on a small scale in the spring of 1916. This was done by stirring into greenhouse soil flask cultures of the Sclerotium on wheat straw and planting wheat therein. Pots so prepared and control pots containing sterilized wheat straw were left in the greenhouse until warm weather and then placed out of doors. The enforced absence of the writer on field trips resulted in some neglect of the plants during the summer. Many of the plants in inoculated and

control pots alike succumbed to unfavorable conditions. When final observations were made on August 4, however, results were such as to point toward infection of the plants by the organism. Of those that survived, the control plants bore normal, well-filled heads of grain, and the inoculated pots contained many plants with empty, blighted heads. These plants resembled those from which the organism was originally isolated both in the appearance of the head and the region about the crown of the plant. Sclerotia were to be found attached to the crowns of plants at distinct brown lesions (fig. 1, *A* and *B*). In some plants, wefts of white mycelium were to be found within the lower internodes (fig. 1, *C*). Reisolation attempts resulted almost universally in obtaining *Sclerotium rolfsii*. The white mycelium from within affected culms gave pure cultures of that organism, as did also bits of tissue from interior portions of diseased culms carefully sterilized on the surface. Tissue transfers made from the crown of control plants in no case produced *Sclerotium rolfsii*.

It was planned to conduct further experiments on a much larger and more comprehensive scale during the season of 1917. Owing to a change of duties, however, the writer found this impossible to accomplish. It is thought that the work here recorded, while perhaps not sufficient to establish indisputably the parasitism of *Sclerotium rolfsii* on wheat, is sufficiently indicative of that to warrant calling it to the attention of those who may do further work with that organism.

G. H. GODFREY

On the preservation of phytopathological specimens in their natural colors. In the preservation of plant specimens, either dry or in fluid, it is impossible, with the methods now available, to retain the natural colors undeteriorated. In drying, plant tissues grow dull and lifeless and, when highly colored or white, not infrequently completely lose their characteristic coloration; when specimens are preserved in fluid their pristine coloration becomes also duller, if not entirely lost, and the medium grows synchronously more or less discolored. To be sure, green parts of plants can be very successfully preserved in formaldehyde by first fixing in cupric acetate as recommended by Trail,[1] and excellent results may be obtained by the same method with diseased material when the characteristic symptom of disease in follicuious parasites is a dark-colored fruit body, as for instance in hollyhock rust, tar-spot of maple, and sooty mold of clover. Fixing green parts in cupric acetate when they are variously colored or affected with parasitic organisms having colored fruit bodies

[1] Trail, J. W. H. Museum preparations. The preservation of green colors in botanical specimens exposed to light. Bul. Misc. Inform. Kew, **2**: 49–52. 1908.

does not, however, give satisfactory results; the chlorophyll is fixed but the colors are destroyed or much impaired.

Since the darkening of plant organs when dried or preserved in fluid is due to oxidation, it has seemed that the coloration of specimens would be much improved if they could be treated with a reducing agent in such a way as to inhibit oxidation. In the arts and industries sulphur dioxid is commonly used for this purpose. It has also been employed by Quin[2] for the preservation of dried flowers in their natural colors, and by Strasburger[3] for the preservation of Monotropa in fluid.

For the preservation of dried flowers, Quin recommends that the sulphur dioxid be allowed to act until the color is discharged; but the writer is of the opinion that even for floral specimens the colors will frequently fail to return properly when this author's directions are too literally followed, and his experience indicates that the material should be removed from the sulphur dioxid as soon as the color most difficult to retain begins to fade. In other words, the exact degree of sulphuring required is determined by the character of the specimen to be preserved. When the parts to be preserved are colorless, the sulphur dioxid should be allowed to act considerably longer than when they are brightly colored or green. Pale and translucent objects require longer sulphuring than dark opaque objects, and when a specimen darkens too much on drying longer exposure is indicated. On the other hand, should a color fail to appear, too long an exposure has been given.

For the preservation of specimens in fluid, preliminary immersion in alcohol saturated with sulphur dioxid, as used by Strasburger to prevent the blackening of Monotropa, is applicable only for colorless objects, but the following method may be used satisfactorily for the preservation in fluid of specimens in their natural colors provided the coloring matter is not soluble in water. The *modus operandi* I have used is as follows:

A specimen jar of appropriate size is filled with a 1 per cent solution of sodium bisulphite; citric acid (or other acid, preferable organic) is then added until a strong odor of sulphur dioxid is given off, when the specimen to be preserved is placed in the solution and the jar sealed. At the end of one-half to two hours (sometimes longer) the jar is opened, the bleaching solution immediately poured off, replaced once with water and then with a 4 per cent solution of formaldehyde. The specimen is to remain permanently in this solution.

In general and unless experience teaches to the contrary, the bleaching solution should be allowed to act only until the color most difficult to

[2] Bailey, L. H. The Horticulturist's Rule-Book, fourth edition, 1896, p. 182.

[3] Strasburger, E. Handbook of Practical Botany, English translation, seventh edition, 1911, p. 401.

retain begins to fade. Delicate herbaceous specimens will usually require a short exposure, while wood will require sometimes a very long exposure. If exposure to the bleaching solution has been too long, one or more colors will fail to return, but if it has not been sufficiently prolonged, then the formaldehyde solution will in time discolor.

That the method above described is extremely adaptable will be evidenced at once from the fact that the following specimens, among others, have been successfully preserved by its use: *Plasmodiophora brassicæ* on cauliflower, nematode galls on cucumber, *Exobasidium vaccinii* on *Azalea indica*, *Venturia inæqualis* on green apples, *V. pyrina* on green pears, *Plowrightia morbosa* on cherry, *Phytophthora infestans* on potato tubers, *Bacillus amylovorus* on branches of apple, and *Colletotrichum lindemuthianum* on bean pods.

O. BUTLER

Personals. Mr. Frank C. Anderson, formerly a graduate student at the University of Wisconsin, who was transferred from the Plant Disease Survey office to the office of Cotton, Truck, and Forage Crop Disease Investigations, Bureau of Plant Industry, and stationed at Athens, Georgia, to take charge of extension work on the control of cotton, truck crop, and forage crop diseases in that state has resigned to enter the military service.

Dr. Caroline Rumbold, formerly a collaborator in the office of Investigations in Forest Pathology, Bureau of Plant Industry, has been appointed assistant pathologist in the office of Sugar Plant Investigations of that Bureau.

Mr. Wm. L. Doran, formerly instructor in botany at the New Hampshire College of Agriculture and assistant botanist of the New Hampshire Experiment Station, has been appointed extension plant pathologist for the Bureau of Plant Industry, with headquarters at Amherst, Massachusetts.

ABSTRACTS OF PAPERS PRESENTED AT THE NINTH ANNUAL MEETING OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, PITTSBURG, DECEMBER 28, 1917, TO JANUARY 1, 1918

Soft scald of apples and cherries. CHARLES BROOKS and D. F. FISHER

Certain varieties of both apples and cherries develop soft scald when inclosed for a short time either in air or in an atmosphere composed partly or entirely of carbon dioxid. The rapidity of this scald increases with an increase in the percentage of carbon dioxid or an increase in temperature. At 25° or 30°C. soft scald develops in three to seven days, but at 15°C. little is evident at the end of three weeks. The disease is characterized by a fading of the red color of the skin and a softening and browning of the flesh. With apples, especially with Jonathan and Rome Beauty, there is usually a sharp demarcation between the sound and scalded flesh, and punc-

tures, bruises and points of contact with other apples or the container seem to furnish the starting points for the disease. With both apples and cherries a film of moisture over the fruit favors the development of soft scald.

Air movement as a factor in the prevention of apple scald. CHARLES BROOKS and J. S. COOLEY

Grimes Golden apples stored at 15°C. in practically saturated atmospheres containing 1.5 to 5 per cent of carbon dioxid have become badly scalded when there was little or no air movement, but have remained free from scald in similar atmospheres when the air was kept in constant motion by means of Crowell air pumps. Other experiments have indicated that air movement is a similarly important factor in influencing the occurrence of scald at lower temperatures.

Delayed ripening of tomatoes caused by spraying with Bordeaux mixture. C. W. EDGERTON

Spraying experiments on tomatoes carried through three years have shown that Bordeaux mixture materially delays the ripening of the fruit under Louisiana conditions. This delay means decreased profits with a truck crop where earliness is essential. Spraying seems to be advisable only during seasons in which there is a serious outbreak of the early blight (*Alternaria solani*). The gain produced by the control of the leaf mold (*Cladosporium fulvum*) and a moderate amount of the early blight by spraying with Bordeaux mixture is more than offset by the loss caused by delayed ripening.

Resistance and susceptibility of certain wheat varieties to loose smut. G. H. COONS and F. A. SPRAGG

In strains of wheat grown in the plant breeding plots at East Lansing, Michigan, the following difference in percentage of loose smut was found:

YEAR	SHEPHERD'S PERFECTION 61801	GOING'S 78501	REMARKS
	per cent	*per cent*	
1908	Less than 1*	20*	Planted side by side, difference in smut noted. No figures recorded
1909	Less than 1*	20*	As above
1910	1	20	
1911	Less than 1	20	A few smutted heads here and there in Shepherd's Perfection. Plots were in duplicate
1912	0	7	Wheat winter-killed badly

* From memory.

One hundred heads of each variety were chosen when at the same stage of development. Fifty were bagged at once. The rest were inoculated with *Ustilago tritici*. The spores were rubbed into some heads, blown into others and spore-laden water was put on the stigmas in some cases. A portion of the grain so obtained was planted with the following results:

TREATMENT	STAND	SMUT
	per cent	*per cent*
Goings, bagged, check	100	0
Goings, inoculated	70	24
Shepherd's Perfection bagged, check	100	0
Shepherd's Perfection inoculated	100	0

There evidently exists in these strains marked differences in resistance which can not be assigned to mere disease-escape.

Many of the kernels of the inoculated Goings wheat were shriveled and poorly developed. The poor stand seemed associated with weakening by loose smut. Smutted wheat seems more likely to succumb to winter-killing than healthy wheat.

Potato seed treatment. R. E. VAUGHAN and J. W. BRANN

Mercuric bichlorid (1-1000) was used in disinfecting standard varieties of tubers which were planted on soil where potatoes had not previously been grown. Chemical analysis was made of the bichlorid after each successive treatment which showed a progressive weakening of the solution. The weakening was more pronounced where the tubers were excessively dirty. At harvest, a much greater amount of scab (*Oospora scabies*), was present on the tubers from untreated seed. But little Rhizoctonia was present for comparison. The Rural New Yorker showed less scab than any other variety tested.

Control of neck rot and anthracnose of onion sets. J. C. WALKER

Neck rot causes very serious losses of onion sets annually, especially of white varieties. Infection apparently takes place at about harvest time through the wounds at the neck of the bulbs, and the disease progresses during the curing and storage period. Moist weather at and directly following harvest seems to cause a marked increase in the amount of rot. Proper curing at harvest time seems to materially reduce the rot.

Experiments were performed in the fall of 1917 to determine the effect of artificial curing on neck rot. White sets were dried at harvest time in shallow crates at 90° to 120°F. for various lengths of time and then removed directly to the warehouse. In the different experiments the percentage of rot has been reduced respectively from 14 to 1 per cent; from 47 to 7 per cent; from 53 to 7 per cent; and from 92 to 10 per cent. Forty-eight to seventy-two hours' drying seem to be sufficient to control the disease satisfactorily in most cases.

Inasmuch as anthracnose starts about harvest time and increases rapidly in the curing crates during moist weather the artificial drying has been found in some cases to materially check this disease also.

Notes on the resistance of onions to anthracnose. J. C. WALKER

White onions are susceptible whereas red and yellow varieties are decidedly resistant to the anthracnose organism. Even dry outer scales of the colored bulbs are seldom attacked. However, the portion of the scales around the neck containing little or no coloring matter commonly acquire the disease. Greenhouse experiments show the fungus to be capable of damping off red, yellow, and white varieties alike.

The coloring matter is in solution in the sap of epidermal cells and is easily extracted in water. When small bits of dry outer scales of either red or yellow varieties are placed in a drop of water with the spores of the fungus, normal spore germination is inhibited. Some spores simply become swollen, others send out short, thick, abnormal germ tubes; but in most the germ tube, after starting, bursts and a mass of naked cytoplasm accumulates alongside the spore. When bits of dry outer scales of white onion are similarly placed normal germination occurs. Similar differences result from the use of colored and uncolored parts of the same scale. There is a close correlation between coloring matter, inhibition of germination and resistance. The volatile substances from fleshy scales of the onion are also capable of inhibiting the germination of the spores.

Quince rot. F. E. KEMPTON and H. W. ANDERSON

Severe rotting of quinces was noticed in the fruit from the markets the past season. A black rot due to *Sphaeropsis malorum* (*Physolospora cydoniæ*) and a pale rot similar to that described in 1895 by Halsted were the most common. The latter was by far the more serious of the two, and a special study was made of it.

On the fruit this rot first gives a grayish appearance, later purplish, and then brown. Finally the quince dries to a mummy, becoming much wrinkled before hardening. The fungus causing this rot was isolated and cultural studies made. Inoculations on the fruit caused a rapid rotting identical with that observed on quinces from the local market.

Concerning a tubercular structure at the base of certain Hyphomycetes. F. L. STEVENS

A structure indicating relationship with the Tuberculariaceæ is described as occurring in several species of fungi which would, except for the presence of this structure, be placed in the Moniliaceæ.

Resistance of sorghum types to covered kernel smut. ALDEN A. POTTER and LEO E. MELCHERS

Using a selection of varieties representing all the commercial types of *Sorghum vulgare*, all of which were inoculated and planted in duplicate at Manhattan, Kansas, and Amarillo, Texas, a series of tests have been conducted during the past two seasons to determine the resistance of varieties to *Sphacelotheca sorghi*, the covered kernel smut. None of the different types have been found to be immune, so that in developing new varieties by hybridization and selection the plant breeder can not expect to isolate immunity as a unit character, as he might heretofore have expected to do in crossing with milo and with Feterita, both of which have been reported as immune from smut. These types are, however, highly resistant. A number of the durras, and also a dwarf kaoliang variety, have produced little or none of the disease. Kafir and broomcorn, and varieties of the sweet sorghum or sorgo group, have been found to be generally susceptible, as are also many of the varieties generally classed as durras. Kaoliang varieties have generally shown a moderate degree of resistance.

Dry rot of gladiolus. L. M. MASSEY

One of the most common corm diseases of the gladiolus is dry rot. The corms become infected in the field. Due to the advancement of the rot in storage many corms are reduced to dry mummies. The lesions are usually small, more or less circular, with a definite somewhat sharply defined margin, and of a brown to brownish black color.

No spore form of the causal organism has been found. Small sclerotia have been observed on diseased plants and are formed readily and abundantly in culture. For the present the fungus is referred to the form-genus Sclerotium.

The species of Tilletia on wheat. ALDEN A. POTTER and G. H. COONS

Although Kühn first described *T. lævis*, in 1873, as a species distinct from *T. tritici* (Bjerk.) Wint., Harwood of Michigan, in 1892, was the first to note a difference by which these two species could be distinguished in the field. The writers have confirmed this observation that *T. tritici* produces a stunting effect under the conditions and on the varieties grown in Michigan, and have noted other differences in the morphology of the affected spikes and spikelets, in the shape of the sori, and in the consistency of the spore mass. If these differences may be considered to be of general importance, their probable relation to the distribution of the species and to the economic aspects of the bunt problem, such as soil infestation, explosions in threshing separators, and the commercial condition of "smutty" grain when thrashed becomes a matter of much interest.

A new Sclerotium disease of lawn grasses. A. VINCENT OSMUN and W. S. KROUT

The so-called burning out of lawns, and putting greens, in small, usually circular, areas has been under observation several years. A sclerotia-forming fungus found on diseased plants was isolated and the disease repeatedly produced under control by inoculation from pure cultures. This paper is based on field and greenhouse observations, and laboratory study.

The disease appears to be primarily one of young grasses which damp-off shortly after appearing above ground. On older growth the lower part of the culms, sheath and first leaves are attacked. Under moist conditions the gray, fungus growth may be seen spreading throughout the dead areas.

Poa pratensis L., *P. annua* L., *Agrostis canina* L., *A. alba* L., *Trifolium repens* L., and undetermined species in lawn mixtures were found diseased in the field.

Infection by artificial inoculation was accomplished on *Agrostis alba* L., and forma *stolonifera*, *Phleum pratense* L., *Cynosurus cristatus* L., *Lolium perenne* L., *Trifolium hybridum* L., *T. pratense* L., *T. repens* L., *Melilotus officinalis* (L.) Lam., *M. alba* Desr., *Medicago sativa* L., and *Vicia* sp.

Mycelium hyaline, except in sclerotia, spreading from plant to plant in web-like fashion. Sclerotia first white, later brownish-black.

Formaldehyde gave control in the greenhouse.

Third progress report on investigations of leaf spot of cherries and plums in Wisconsin. G. W. KEITT

The lines of investigation mentioned in earlier progress reports have been continued and extended. A report on the cross-inoculation experiments is in process of preparation. Only the control work is reported here.

Spraying. (Varieties Montmorency and Early Richmond.) As in 1916, the disease was very severe in early summer, but made relatively little progress after July. The results of the spraying experiments confirmed those of 1916. The disease was satisfactorily controlled by Bordeaux mixture, 4–4–50, 3–3–50, and 2–2–50, and lime-sulphur (commercial concentrate, 33°B.), 1–40, applied (1) several days after the petals fell, (2) sixteen to seventeen days later, and (3) just after the fruit was harvested. "Atomic sulphur," 5–50; "barium-sulphur," 3–50; and self-boiled lime-sulphur, 8–8–50; in parallel applications did not control the disease satisfactorily.

In all these tests arsenate of lead powder, 3/4–50, was added to the fungicides. Satisfactory commercial control was secured with Bordeaux mixture, 3–3–50, and lime-sulphur, 1–40, when the third treatment was omitted. A treatment before the blossoms opened proved to be unnecessary.

Sanitation. The results of further experiments and observations relative to sanitation confirm those of 1916, and show that the spray schedule may be strongly reinforced by turning under the fallen leaves as completely as is feasible by clean cultivation before the blossoms open.

A surface storage-rot of sweet potatoes. L. L. HARTER and J. L. WEIMER

A form of surface rot of sweet potato in storage is becoming increasingly important each year in the northern section of the sweet potato belt. Infection seems to take place at about digging time through the small dead or dying rootlets.

The development of the fungus in the infected areas is slow, requiring about six to eight weeks to produce a spot one-half inch in diameter. These are characterized by being shallow, somewhat sunken, brownish in color and irregular in shape. The infections are numerous, thus rendering the potatoes unsalable or greatly reducing their market value.

From these spots a Fusarium has been isolated, which is very similar, if not morphologically identical, with *F: hyperoxysporum.* In fact some of the strains of this species successfully infected the plants while others would not. The strain which infected the plants in the field would also produce the surface rot infection.

This type of storage rot is most prevalent and destructive when the potatoes are dug during a wet time and when stored without properly drying.

Storage-rots of sweet potatoes. L. L. HARTER and J. L. WEIMER.

During a period of five years that sweet potato storage rots have been under investigation, about twenty-five different organisms have been studied. Fifteen of these are found to produce rots under certain conditions. *Rhizopus nigricans, Sphæronema fimbriatum, Sclerotium bataticola, Diaporthe batatatis,* and *Diplodia bataticola* are the most important and most frequently met with. Other organisms studied and found to cause storage rots under special conditions are *Mucor racemosus, Alternaria* sp., *Botrytis cinerea, Penicillum* sp., *Epicoccum* sp., *Plenodomus destruens, Gibberella saubinettii, Fusarium incarnatum,* and *F. acuminatum.*

The following organisms have been frequently isolated from decayed potatoes but have consistently failed to produce decay when inoculated into healthy potatoes: *Fusarium radicicola, F. batatatis, F. hyperoxysporum, F. caudatum, Mucor* sp., *Nectria ipomœæ, F. solani, F. oxysporum, F. lancea, F. orthoceras,* and *F. orthoceras var. triseptatum.*

Notes on some western Uredineæ. GEO. G. HEDGCOCK, E. BETHEL, and N. REX HUNT

The pycnia of *Peridermium pyriforme* Peck are borne on areas of the bark of pines contiguous to the aecia and preceding them one year. They are produced in the portions most recently invaded, commonly on the trunks and limbs.

The pycnia of *Peridermium filamentosum* Peck are borne on the twigs and smaller limbs of pines on more newly invaded areas, usually on the portion nearer to the tips or ends, and beyond the aecia, and they precede the aecia one year.

In case of both *Peridermium pyriforme* and *P. filamentosum* the pycnia most frequently appear at a date later in the season than the aecia.

Peridermium filamentosum and *Peridermium harknessi* Moore although both have

their uredinial and telial forms on Castilleja (*Cornartium coleosporoides* Dietel & Holway) are considered to be either distinct races of the same fungus, or, what is more probable, distinct species.

Notes on Cronartium cerebrum. GEO. G. HEDGCOCK and N. REX HUNT

Inoculations made with *Cronartium cerebrum* (Peck) Hedgc. & Long from pedigree cultures from cultures from the fusiform type of this fungus (*Peridermium fusiforme* Arthur & Kern) and from the sphaeroid type (*Peridermium cerebrum* Peck) made on pines indicate that the two forms of Peridermium at least belong to distinct races if not to distinct species.

Plum blotch. JOHN W. ROBERTS

A disease caused by *Phyllosticta congesta* Heald & Wolf and affecting the fruit, leaves, and probably the twigs of Japanese varieties of the plum has been found in Georgia.

The diseased parts of the fruit appear as dark raised areas with fringed margins. Later these areas are sunken. The skin of the fruit is often ruptured. Pycnidia containing spores are abundant.

On the leaf blades, small silvery spots are produced. On the petioles and midribs the lesions are black and sunken. Pycnidia containing spores are present.

Pycnidia apparently identical with those on fruit and leaves appeared in obscure lesions on the twigs, but as spores were lacking at the time of examination, positive identification could not be made.

The disease, especially on the fruit, greatly resembles apple blotch due to *Phyllosticta solitaria* E. & E.

Inoculation experiments with pure cultures of the fungus will be carried on in 1918.

Insect transmission of spinach blight. LOREN B. SMITH

It has been found in recent experiments, that spinach blight is a specific, communicable disease, which is transmissible to healthy plants by insects. Several species act as carriers of the blight from diseased to healthy plants in the field, and important relationships have been discovered to exist between the insect carriers and the disease, which add materially to our present knowledge concerning the insect transmission of plant diseases.

As a possible means of control for spinach blight, the destruction of the insects infesting the crop, and thereby preventing to a large extent the spread of the disease, offers the most encouraging possibilities.

Spinach blight. J. A. MCCLINTOCK

In the spinach growing section of eastern Virginia, the blight disease, annually destroys at least 20 per cent of the spinach crop, thus causing losses of over $200,000 each year.

Experiments during the past three years have demonstrated that spinach blight is not a malnutrition disease, due to unbalanced fertilizer conditions, as has been supposed. It is a specific disease, which can be transferred to healthy plants.

The detailed experiments on which our findings are based, will be presented in a forthcoming joint paper, in the Journal of Agricultural Research.

Mosaic diseases of cucurbits. I. C. JAGGER

Inoculations were made by rubbing crushed leaves from cucumber plants, affected with the two mosaic diseases reported a year ago, over the leaves of numerous related

plants. A large number of species and varieties of the family *Cucurbitaceæ* and single species of the families *Lobeliaceæ* and *Compositæ* became infected with the white pickle mosaic disease, while only a relatively few species and varieties of *Cucurbitaceæ* became infected with the mottled leaf mosaic disease. A mosaic disease has been abundant on summer crookneck squash and pie pumpkin during the past summer in the vicinity of Rochester, N. Y., which is distinct from the two above diseases. Repeated inoculations failed to transmit it to cucumber.

Some Verticillium diseases. I. C. JAGGER and V. B. STEWART

Verticillium diseases have been observed on potato, eggplant, barberry, salsify, and numerous species of Solanum, growing in the vicinity of Rochester, New York. Cultures of Verticillium obtained from the various host plants, are indistinguishable in rate of growth, macroscopic appearance of colonies, and formation of sclerotium-like bodies. Cultures of Verticillium from maple affected with the thrombotic disease differ in the rate of formation of sclerotia-like bodies. A fungus isolated from potatoes grown in Canada appears to be *Verticillium albo-atrum* R. & B. and the formation of sclerotium-like bodies on agar media differs from the fungus so common on potatoes and other host plants in the vicinity of Rochester, New York.

The disease of tulips caused by Botrytis parasitica. E. F. HOPKINS

An investigation of tulip diseases covering a period of two years shows *Botrytis parasitica* Cavara to be established throughout the United States. All parts of the host are attacked except the roots.

The pathogenicity of *B. parasitica* on tulips has been established by numerous infections obtained from inoculation with conidia from pure cultures. Inoculations on other hosts failed except in some closely related plants where wound inoculations gave slight infections. The pathogene is evidently a restricted parasite.

This disease of tulips may usually be distinguished from some similar ones by the minute pin-head-sized sclerotia of the fungus, which are to be seen in the outer bulb scales of stored bulbs, and on the rotted necks of affected plants in the beds. The connection between these small sclerotia and the conidial stage on leaf lesions has been fully established. In the tulip diseases caused by another species of Botrytis and in one caused by *Sclerotium tulifarum* Kleb., the sclerotia formed by the pathogenes are much larger than those of *B. parasitica*.

This pathogene is apparently an importation from Europe where it has long been known. It continues to come into this country on almost every shipment of tulip bulbs.

The Botrytis blight of golden seal. H. H. WHETZEL

This appears to be the most common and destructive disease of cultivated *Hydrastis canadensis*. It had appeared in New York golden seal gardens before 1907. In that year, however, it was destructive killing 10 to 20 per cent of the tops. It has since been destructive in the gardens of Michigan and Wisconsin. It is always present in most gardens but is destructive only in wet seasons.

All parts of the host are affected including the root-stocks. Rotting off of the leaf petioles at the base or blighting of leaves are the usual symptoms. Seedlings are frequently killed. Blossoms and seed heads are often destroyed.

The pathogene is a species of Botrytis belonging to the subdivision Microsclerotiæ. The minute sclerotia winter over imbedded in the cortex of diseased petioles. From these and from dormant mycelium, tufts of conidiophores appear in early spring. Conidia from these infect the young petioles and leaves.

The pathogenicity of this fungus on *Hydrastis canadensis* has been fully established by repeated inoculation experiments. Infection failed on all other hosts tested. The parasite appears to be restricted to the one host.

Spraying with Bordeaux mixture has not given complete protection against this pathogene.

Relative susceptibility of beans to rust. F. D. FROMME

Some fifty horticultural varieties of beans have been tested for susceptibility to bean rust (*Uromyces appendiculatus*). Striking variations in susceptibility are exhibited. Resistance may be shown in several ways, e. g.; in a decrease in the number of infections; in the production of flecks indicating the early death of the mycelium and invaded tissue; in a decrease in the size and spore producing capacity of the sorus; and in the early production of teliospores. Some few varieties are only slightly susceptible and for practical purposes may be classed as rust resistant. The majority are classed as susceptible, and a few as very susceptible.

Botrytis sp. causing severe injury to flowers and foliage of Pelargonium hortorum. L. E. MELCHERS

In October, 1916, the writer found *Botrytis* sp. causing severe damage to the blooms of geranium plants. Practically all the geraniums belonging to the college were infected and later this disease was found in many greenhouses in town. The blooms are destroyed before the flowers are all fully developed. Infected petals wilt and drop on the foliage where they serve as a source of infection to leaves. If petals remain intact, the fungus travels down the pedicel. Infected portions turn brown, later black and soon the fungous masses develop and can be seen with the unaided eye. By contact, other flowers are infected. Within a few days the entire bloom is destroyed. Leaves become infected from diseased portions of flowers falling upon them. Definite leaf spots occur and under humid conditions, in greenhouse, frequently the entire leaf and petiole are involved. This disease is not confined to weakened floral parts of leaves which are partially dead. The fungus dealt with proved to be severely pathogenic. Pure cultures of this *Botrytis* sp. (which is closely related to, if not identical with *Botyrtis cinerea*) gave one hundred per cent infection, when spores were applied by means of an atomizer, without injuring tissues. Plants inoculated and not using belljars gave 100 per cent infection. Various sulphur dust compounds did not control this trouble.

Wilt disease of tobacco attributed to Fusarium. JAMES JOHNSON

Attention has been called to a wilt disease of tobacco in Charles County, Maryland, through Dr. W. W. Garner of the Department of Agriculture. The plants in the field wilt at practically any age, this wilting often being first limited to only one side of the plant. The woody portion of the stalk is discolored. That this disease is not bacterial wilt but caused by *Fusarium* sp. is believed evident for the following reasons: (1) Spores of *Fusarium* sp. occur abundantly on the surface, and this fungus has been repeatedly cultured from the vascular tissue; (2) Paraffin sections do not show vessels filled with bacteria as in bacterial wilt using the same staining methods, but do show mycelium and spores; (3) Cutting diseased stems does not yield bacterial ooze; (4) Certain symptoms of the disease are apparently different from that of bacterial wilt.

Although good infection with diseased tissue has been obtained, the evidence of successful infection from pure culture is lacking, after several attempts. The disease is of interest for the reason that Fusarium diseases of tobacco have previously

been described from France and America, but in both instances it appears that they may have been confused with bacterial wilt.

Influence of soil temperature on Thielavia root-rot. JAMES JOHNSON and R. E. HARTMAN

Artificial control of the temperature of Thielavia infested soil, set to tobacco in the greenhouse, has yielded some results of value in explaining the occurrence of epiphytotics of this disease. Using a range of temperature from about 10 to 40°C., it has been found that approximately 23 to 26°C. constitutes a critical temperature in the disease development. At lower temperatures the disease is very marked. Above this soil temperature the amount of disease is reduced to a minimum or does not occur at all. Badly diseased plants transplanted from cooler soils to soil of the higher temperature develop new roots which do not become infected. This higher temperature is, on the other hand, favorable to the tobacco which consequently makes a vigorous growth even in highly infested soils. These results are in accord with disease occurrence and soil temperature as observed in the field.

Puccinia graminis tritici compacti in southern United States. E. C. STAKMAN and G. R. HOERNER

Puccinia graminis tritici compacti was found in 1916 west of the Rocky Mountains. It has been found since then also in an number of southern states. Parasitically and morphologically the strains from the west and south are practically identical, indicating clearly that the *tritici compacti* form is not merely a local variation of the *tritici* form. Hard spring wheats and some winter wheats of the *vulgare* group are very highly resistant, while the same varieties are completely susceptible to ordinary *P. graminis tritici*. The geographical distribution of the *tritici compacti* form is imperfectly known, but, on account of its very distinctive action on many of the common wheats, its presence in the south may be important in rust epiphytotisms.

A Fusarium disease of garden peas in Minnesota. G. R. BISBY

A wilt disease of garden peas was reported in 1916 as injuring a field of several acres and was again troublesome in at least one other locality in 1917. The disease was reported as beginning in spots and spreading. Several species of Fusarium have been found constantly associated with the disease, and the pathogenicity of one species has been repeatedly demonstrated. The fungus was found to cause loss through the rotting of the seed, and to produce wilt of the plants through attack upon the roots and stem. The species has, as yet, not been identified with previously described species. The source of the fungus is uncertain, although the seed from which the infected crop was grown this year was originally imported from England.

Further notes on cucumber mosaic disease. S. P. DOOLITTLE and W. W. GILBERT

During the years 1916 and 1917 the work on cucumber mosaic has been continued. The cause of mosaic is still in doubt. Soil overwintering experiments have given negative results. In a field experiment to determine if the disease overwintered in the seed, one plant out of 5500 from seed from diseased vines showed the disease. A case of undoubted mosaic developed in a young seedling in the greenhouse.

Transmission of the infective principle of mosaic has been proved for striped beetles and pickers also carry it.

Cucumber mosaic has been communicated from cucumber to 18 species in 10 genera

of cucurbits, including wild cucumber (Echinocystis), but not to beans, tobacco or tomatoes. Efforts to infect cucumbers with mosaic of beans, tomato, tobacco, pokeweed, and other plants have given negative results.

Attempts to control cucumber mosaic by sanitary measures combined with insect control, have not given promising results, nor have efforts to secure varieties resistant to mosaic.

Mosaic was found general in Colorado in 1917, and in addition to those states previously noted has been reported this season from California, Pennsylvania, West Virginia, Kansas, Connecticut and Texas. Mosaic is the most serious disease of the cucumber, at the present time, in the pickle growing sections of the Middle West.

Organization and correlation of research and extension work in plant pathology. W. A. ORTON

The events of the past year have brought to plant pathology a special opportunity to render national service through the conservation of food crops by preventing plant diseases.

It is needful that we meet these increasing demands in a way that will secure the widest possible adoption of disease control methods, and the speediest solution of new problems as they arise.

Research must not stop, but should be redirected where necessary to secure concentration of effort on serious diseases of staple crops. Particular attention should be paid to maintaining a close and constant connection between the research laboratories and the extension workers, to insure that all available information may be at the command of county agents and farmers in an accurate and practical form. The work of the United States Department of Agriculture and the state institutions should be correlated and unified. The work to be done during the war is worthy of continuation in peace times, and the great Smith-Lever organization may be expanded to include our war activities.

There should be an extension pathologist in each federal and state laboratory, to serve as the connecting link between the investigators and the extension departments. He should be responsible to the head of the department of plant pathology for his subject matter, and to the extension director in his relations with the county agents, through whom he should work to the greatest possible extent. He may represent both the Bureau of Plant Industry and the state with advantage in many instances.

The requirements for extension pathologists are exacting—farm experience, mature judgment, thorough scientific training, some research experience, and the personality and method of a successful teacher.

It is hoped that this Society will discuss the problems involved in transferring such men from their present places, protecting them from other calls, and training new men to fill the ranks.

The relation of phytopathologists to plant disease survey work. G. R. LYMAN

The Plant Disease Survey is being reorganized as an agency for the systematic collection and distribution of information on plant diseases. Its object is to assist and expedite all pathological work by clarifying the disease situation in the United States and by delimiting the problems involved. To do this it must have the cooperation and active assistance of all pathologists and other botanists in order that every available source of information may be utilized.

The central organization in Washington will collect data on the more general problems, will coordinate and assist in the work of all agencies, and will analyze and pub-

lish all data collected. The local or state organizations will gather information to be reported to Washington and also to be used in work on local problems. The local leaders must be energetic, tactful, and able to command the active assistance of all pathologists and other competent observers. All disease data are worth recording either for use in present or projected research and extension work, or for their cumulative bearing on problems of the future. The recording of these data is an imperative duty and will materially assist plant pathology in its proper development and in the discharge of the great responsibilities now devolving upon it.

Three varieties of hard red winter wheat resistant to stem rust. LEO E. MELCHERS and JOHN H. PARKER

Among wheat varieties grown under severe rust conditions in the rust nursery, Manhattan, Kansas in 1916 and 1917, there are three which showed only very light infection.

Kanred (P762) Kansas Sta. No. 2401
(P1066) Kansas Sta. No. 2415
(P1068) Kansas Sta. No. 2414

They are of the Crimean group, bearded, smooth chaff and red kerneled types. The percentages of stem rust infection recorded were:

1916		1917	
P762	10 per cent	P762	Trace
P1066	5 per cent	P1066	Trace
P1068	5 per cent	P1068	Trace to 25 per cent

Other common varieties showed high degree of susceptibility under the same conditions, both years; the percentage ranging from 40 to 98.

Greenhouse results have still more firmly established the true resistance of these wheats. Among 150 varieties inoculated in seedling stage and at heading time, all were found to be susceptible except the three mentioned. On these, no uredinia were formed, either on seedlings or older plants. Between 240 and 300 seedling leaves of each of the three varieties were inoculated; the work extended over a period of four months, and was performed by four persons at two different stations. Checks of a susceptible variety were inoculated with each series studied, and were always heavily infected.

This is probably the first time, at least in America, that such marked resistance to stem rust has been shown to exist in varieties of common wheat, *Triticum vulgare*.

Cucumber angular leaf-spot and anthracnose overwintering and seed treatment control. M. W. GARDNER and W. W. GILBERT

Observations on 75 cucumber fields in Wisconsin and Indiana, where seed treatment control of angular leaf-spot and anthracnose was being tried, showed that 90 per cent of the anthracnose cases were attributable to overwintering in the field while but 25 per cent of the angular leaf-spot cases could be traced to a previous crop. In thirty check fields, 73 per cent of the anthracnose cases were traceable to a previous crop and 38 per cent of leaf-spot cases. In a test with disease-free seed planted on four fields, three of which were new, anthracnose occurred only on one field where cucumbers were grown in 1916 and angular leaf-spot was serious only on this field.

In seed treatment tests with mercuric chlorid, 1–1000. for five minutes, out of 75 treated and 73 check fields in Indiana and Wisconsin, 37 per cent of treated fields showed angular leaf-spot as compared with 76 per cent of checks. Eliminating fields where the causal organism may have overwintered, 28 per cent of treated fields

showed the disease as compared with 52 per cent of checks, a 24 per cent gain apparently traceable to seed disinfection.

Small field tests at Madison, Wisconsin, gave even more striking results indicating the value of seed treatment for angular leaf-spot control.

Lightning injury to crops. Records of observations. L. R. JONES, W. W. GILBERT and M. W. GARDNER

Additional notes on lightning injury to Irish potatoes and other crops will be given by Dr. Jones. The first case of lightning injury to be reported on a vine crop was noted by Messrs. W. W. Gilbert and M. W. Gardner near Big Rapids, Michigan, about the end of August, 1917. As in previous cases of lightning injury to other field crops, the plants were killed in a central circular area 30 to 40 feet in diameter and in a peripheral zone 8 to 10 feet wide the injury gradually diminished.

Tomato selection for Fusarium resistance. C. E. DURST

The Department of Horticulture of the University of Illinois has been investigating the fusarium wilt of tomatoes for five years in southern Illinois.

Attempts to control the disease by the use of soil fungicides have resulted in failure.

In tests of a large number of varieties on infested soil, susceptibility to Fusarium has been found to vary widely in different varieties. Unfortunately, those which show the greatest resistance are, for the most part, lacking in other important respects, being of too late maturity or having fruit of undesirable size, color, or shape.

As a result of selection, strains have been developed, from varieties possessing desirable marketable characteristics, which are capable of living through the season in thoroughly infested soil. Plants from the original stock, grown in comparison, die prematurely.

During the past season some of the improved stock produced over two times as much marketable fruit as seedsmen's stock. Of 74 lots grown, the 14 highest yields were produced by selected strains.

Longevity of Helminthosporium teres. ARTHUR L. BAKKE

It has been the general opinion that the spores of certain of the imperfect fungi are especially resistant. Such an opinion is placed upon a firmer basis from the results of the following test. On January 9, 1911 portions of barley stems and of barley leaves were placed with 5 cc. of water and subsequently sterilized at 15 pounds pressure for fifteen minutes. Spores of *Helminthosporium teres* from a plain agar culture were transferred to the sterilized leaf. In one of the series the leaf was entirely coated with the conidia and appeared entirely black, while in the other set grayish white areas, the pycnidia, were distributed here and there. A tube of each, that is one containing the conidia and the other the pycnospores, remained in a card index filing case until November 7, 1917, when transfers were again made to oats and bean agar. In the case of transfer of conidia there was visible growth and pigment in twenty-four hours and in five days the entire surface was covered with these spores. Transfers from the tube containing pycnospores gave visible evidence of growth in less than five days.

A wilt disease of maples. L. A. ZIMM

This disease was first reported in Phytopathology **4**: 395, 1914 as being caused by *Acrostalagmus* sp. With our present knowledge, the organism should apparently be classed under the genus Verticillium. Three strains of this Verticillium from maples

from different localities have been isolated and grown in comparison with similar organisms from potato, eggplant, and barberry. All of the strains appeared entirely different from *Verticillium albo-atrum* attacking potato. The maple strains differed among themselves in the abundance of the sclerotium-like bodies formed in agar and in the amount of aerial mycelium produced. These characters also varied with the media used, oat agar giving the best production of the sclerotium-like bodies and the least amount of aerial mycelium. The eggplant and barberry strains appeared to be closely related to one of the strains from maple. Several trees of *Acer saccharum* Marsh., *A. rubrum* L., and *A. platanoides* L. were inoculated and the typical wilt produced. The young shoots lost their leaves several weeks after inoculation and by the end of the summer the twigs were dead. The mycelium of the fungus was found in the tracheae of the wood and the petioles of the fallen leaves, the wood of the shoots being uniformly discolored. *Acer platanoides* L. was found to be most susceptible to the fungus in this experiment. The fungus was reisolated from the inoculated trees.

Seed treatment with hot solutions of formaldehyde and mercuric chlorid. I. E. MELHUS

Solutions of formaldehyde and mercuric chlorid, two pints in 30 gallons of water, and two ounces in 15 gallons of water respectively, held at 48° to 50°C. for five minutes, have proved fully as effective for the control of the common scab of potato as the formulae of these compounds commonly recommended. Results to date indicate that, of the two, formaldehyde is the more effective. When heated to 55° however, the solutions of these chemicals in the above proportions injure germination. In practice this method has proved time saving as well as effective.

The results obtained with potatoes suggested that the same method might be equally effective for oat smut and barley stripe. Different lots of oats showing 4.84 per cent loose smut, when treated one minute in a formaldehyde solution 1 part to 320 parts water at 45°, 50°, 55° and 60°C. respectively showed no smut infection. Solutions of formaldehyde 1 part to 160 parts of water at 55°C. retarded germination. Mercuric chlorid 1 part to 1000 parts of water for one minute at temperatures between 45° and 60°C. did not entirely eliminate the smut.

Formaldehyde 1 part to 320 parts of water for five minutes at 50°C. reduced the barley stripe disease from 2.86 to 0.07 per cent. Mercuric chlorid 1 part to 1000 parts of water at the same temperature and time reduced the stripe diesase to 0.36 per cent.

Factors influencing the uredospore germination of Puccinia coronata. L. W. DURRELL

The factors influencing the germination and growth of uredinio spores of *Puccinia graminis* are well defined but definite knowledge regarding *P. coronata* is not available.

In the study of this rust it has been found that spores in an atmosphere at or near the point of saturation will not germinate. They must lie on a film of water in order to germinate. Spores in suspension in water however fail to germinate or do so very slightly. Further, uredinio spores in the absence of oxygen fail to germinate. On the other hand when the drop cultures were in contact with paraffin-oil or vaseline, the percentage of germination was materially increased.

The results of 1500 tests indicate that the cardinal temperatures for the germination of uredospores of *P. coronata* are as follows: minimum 0° to 2°C., optimum 18° to 22°C., and maximum 35°C.

Spores placed out of doors in vials during January and February 1917 were not viable after ten days. Spores exposed to 5°C. were reduced to 1.5 per cent germination in thirty days, while in fifty-three days they were all dead. At 30° to 35°C. the results were the same though in the control held at 13° to 20°C. for the same length of time the spores still showed 20 per cent germination .

Spores increase in germinating capacity up to the third and fifth day after the appearance of the pustules and from that time on steadily decrease. Spores gathered and stored in vials respond the same way.

LITERATURE ON PLANT DISEASES[1]

COMPILED BY EUNICE R. OBERLY, LIBRARIAN, BUREAU OF PLANT INDUSTRY, AND FLORENCE P. SMITH, ASSISTANT

November, 1917

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As folhas de roseira estão atacadas pelas seguintes molestias. (*Phragmidium subcorticium, Sphærotheca pannosa, Marsonia rosæ.*) Os ramos e as folhas da laranjeira estão atacados pelas seguintes molestias (*Trichosphæria* sp., *Myriangium citri, Septoria arethusæ*).

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[1] This list includes references, both American and foreign, to the literature of plant pathology and mycology of interest to pathologists. Foreign references published since January 1, 1917, have been included beginning with the list appearing in v. 7, no. 3, June, 1917.

All authors are urged to coöperate in making the list complete by sending their separates and by making corrections and additions, and especially by calling attention to meritorious articles published outside of regular journals. Reprints or correspondence should be addressed to Miss E. R. Oberly, Librarian, Bureau of Plant Industry, U. S. Dept. Agric., Washington, D. C.

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